Iron Sources Modulate Southern Ocean Phytoplankton Responses To Ocean Acidification

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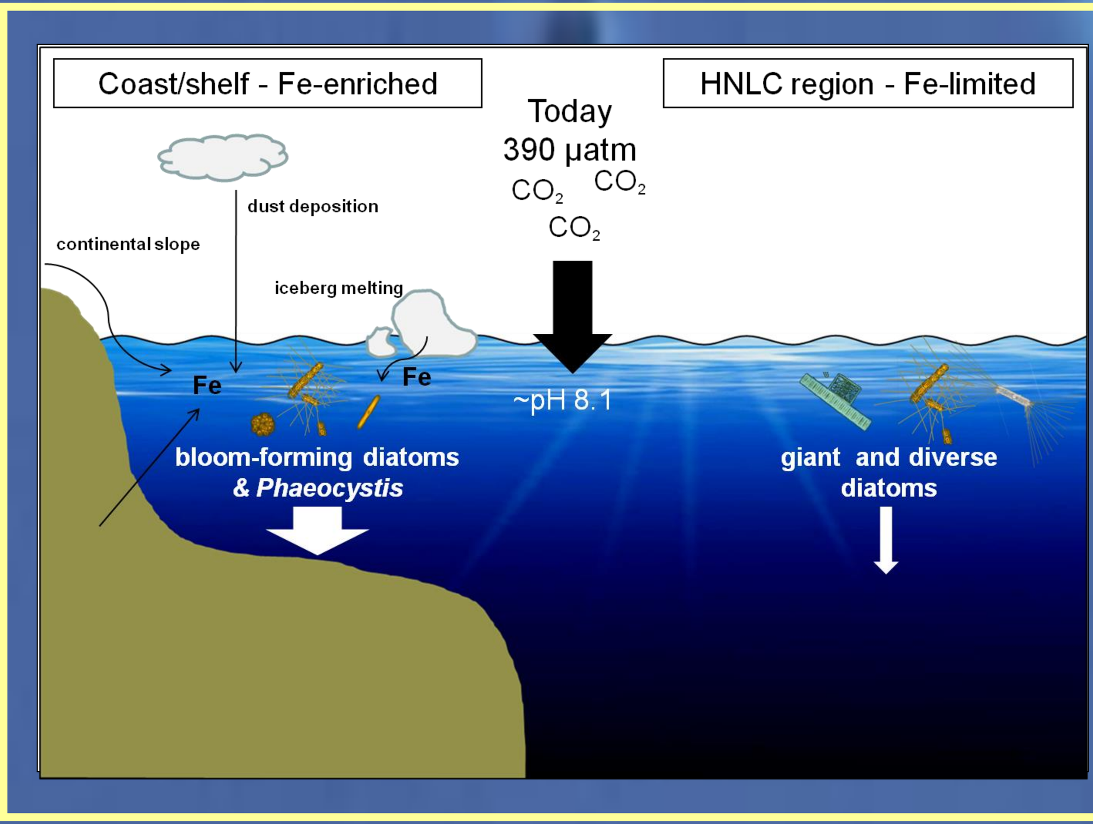
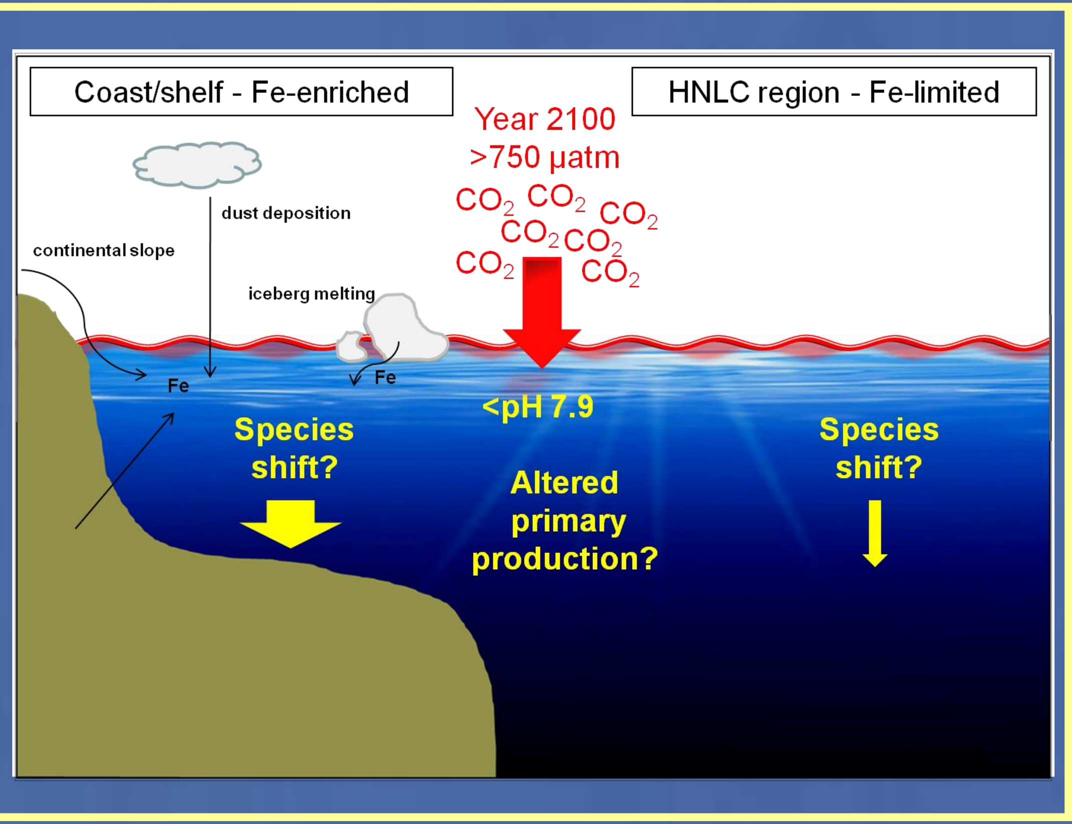


Introduction

- Ocean acidification (OA): antropogenic rise in pCO_2 lowers pH due to fossil fuel burning
- OA affects iron (Fe) chemistry, enhancing potentially Fe solubility
- dust is important Fe source to open waters of the Southern Ocean
- Fe addition experiments mostly use inorganic Fe ($FeCl_3$ or $FeSO_4$)
- Can inorganic Fe addition mimic natural Fe enrichment?

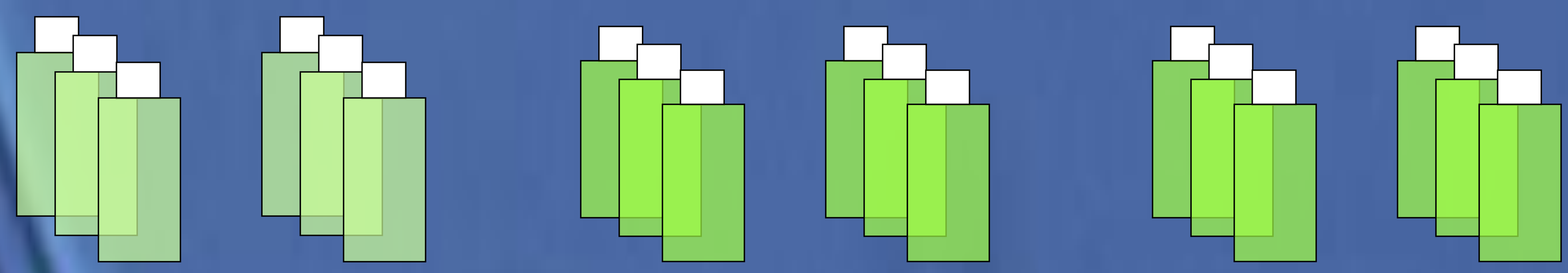
How will OA and dust input will affect Southern Ocean phytoplankton growth?



Ship-board bottle manipulation experiments:

- 53° S 10° E Atlantic Sector South of Polar Front
- natural Fe-limited phytoplankton assemblage (0.2 nM Fe L^{-1})
- 390 and 800 μatm pCO_2 incubations
- equimolar concentration of 0.5 nM Fe L^{-1} added as $FeCl_3$ or dust

Control (no addition): | **Dust (+0.5 nM Fe):** | **$FeCl_3$ (+0.5 nM Fe):**

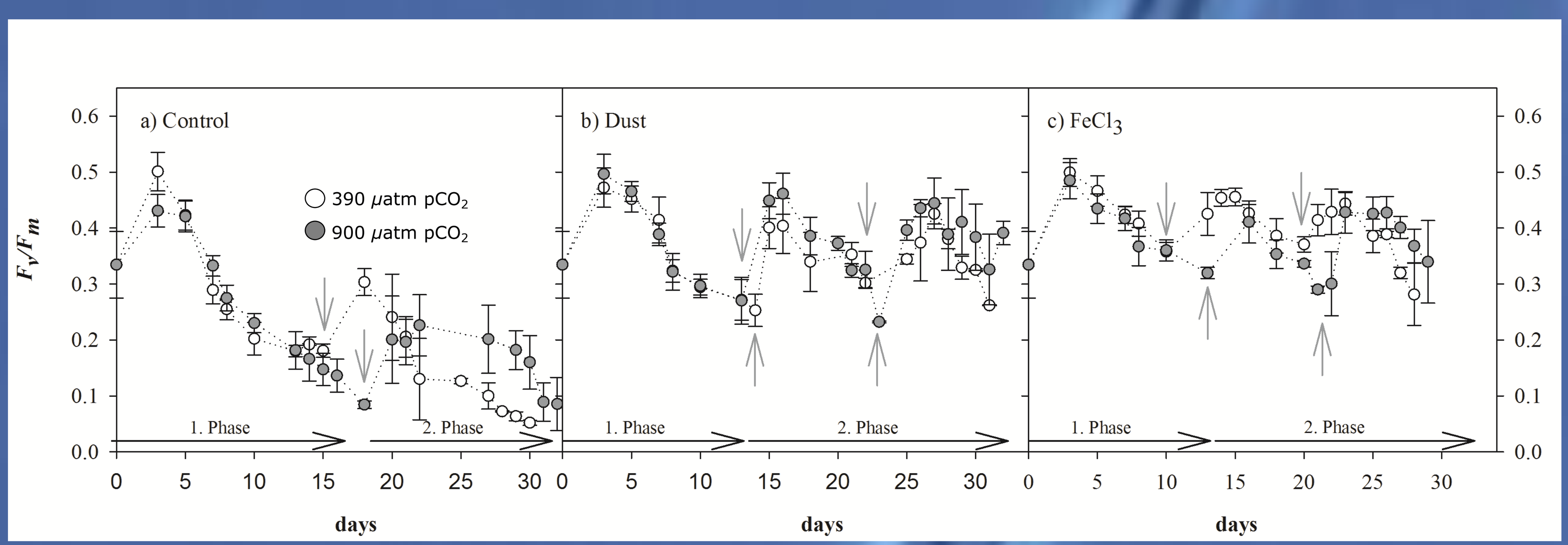


pCO_2: 390 900 390 900 390 900

Results

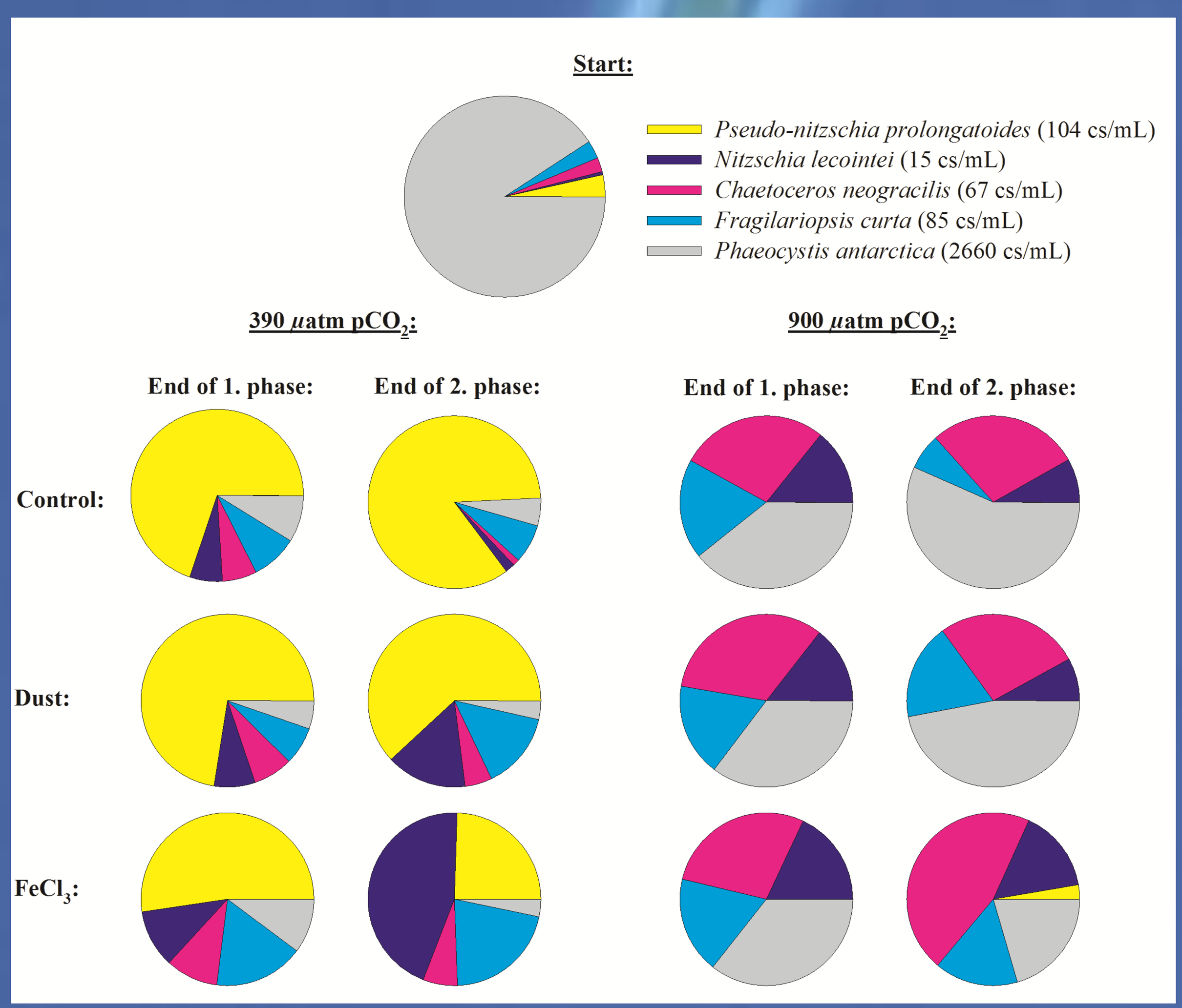
I) Development of the maximum quantum yield of photosystem II (F_v/F_m) over the course of the experiment.

The grey arrows indicate when incubations were diluted with the initially collected filtered seawater.

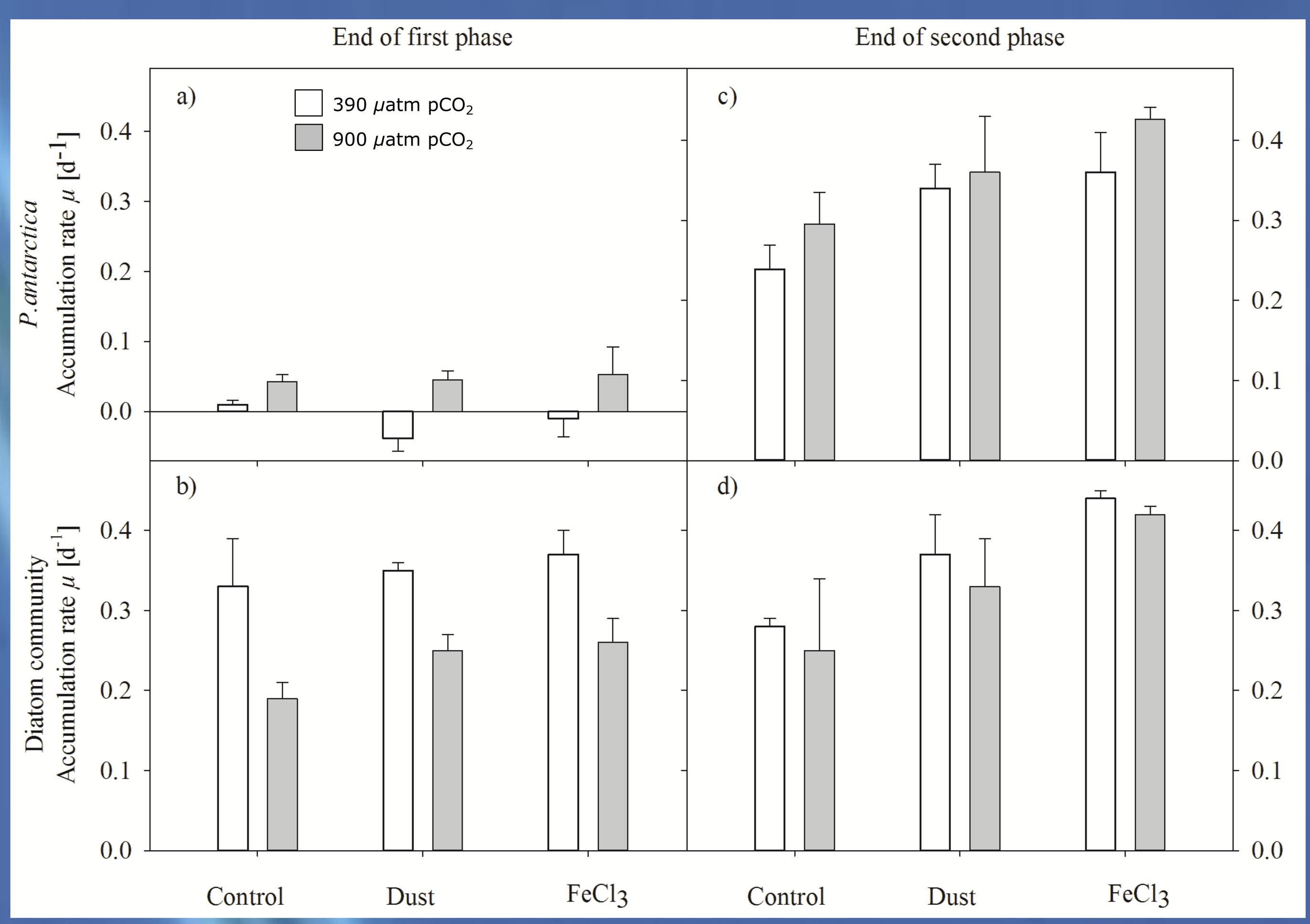


II) Development of abundances of the five phytoplankton species responsive to pCO_2 and iron sources.

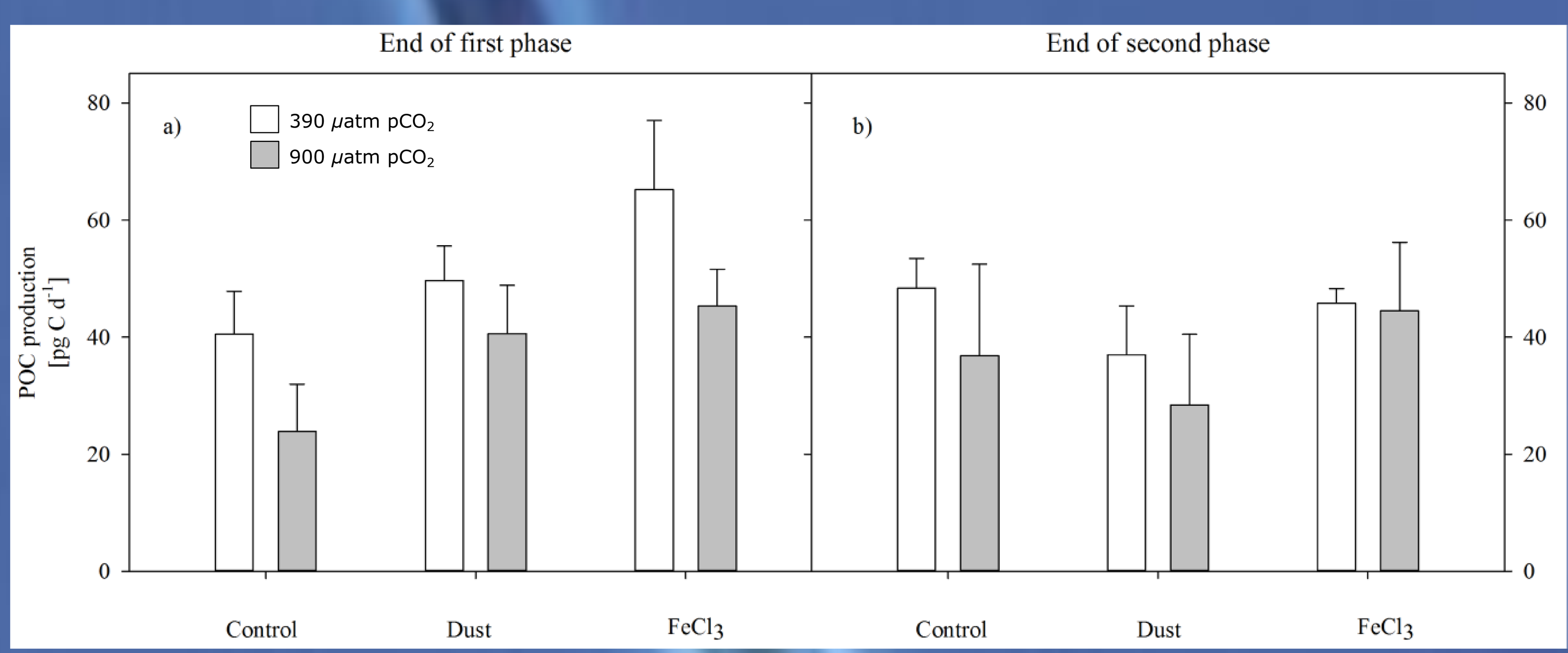
Their relative contribution is shown at the start and after incubation of control-, dust-, and $FeCl_3$-treatments in response to 390 and 900 μatm pCO_2 at the end of the 1. and 2. phase.



III) Accumulation rates (μ, [d^{-1}]) of *Phaeocystis antarctica* and the total diatom community in response to pCO_2 and iron sources.



IV) Daily production of particulate organic carbon (POC, pg C d^{-1}] in response to pCO_2 and iron sources.



Conclusions

End of 1. phase:

- CO_2 alone controlled phytoplankton community composition
- Fe solubility associated with dust was not significantly enhanced under OA

End of 2. phase:

- both CO_2 and Fe sources controlled phytoplankton community
- dominating species markedly differed between $FeCl_3$ and dust enrichments
- POC production rates were similar in all treatments

Implications from OA for Southern Ocean phytoplankton

Dominance of *Phaeocystis antarctica* and minor contribution of thick shelled diatoms under relevant OA scenarios (control and dust treatments) could significantly weaken future carbon and silicate export.

Backgroud picture has been kindly provided by Philipp Assmy